supposed to be seen at a distance of two miles. Take the case of two steamers going in opposite directions at the rate of twenty miles an hour. It follows that from the very moment of those on board being aware of each other's position, but three minutes will elapse before they meet. Is not this little enough time to alter a course? And this is premising a clear atmosphere. Should the night be hazy, the oil poor, the wick badly trimmed, or the glass dirty, the distance at which the light can be seen is lessened, and the time to alter a course correspondingly diminished. Add to this the presence of a colour-blind or defective far-sighted "look-out" or officer, and there is present every attribute for the accomplishment of those terrible tales of the sea which year after year greet us with an alarming regularity. The *Times* (February 5, 1889), in reporting the terrible collision which occurred in the channel, *in fine clear weather*, in which both vessels (s.s. *Nereid* and s. *Killochan*) went to the bottom in less than five minutes, carrying to a watery grave twenty-three men out of a total of forty-two, remarks: "All inquiries respecting the cause of this disaster lead to the same conclusion, that it was due to one of those astounding errors of judgment on the part of one or other of the navigators which seem to defy all attempts at reasonable excuse." Read in the light we suggest, and the cause is as clear as daylight.

The same may be said of the terrible collision, when, again on a *perfectly clear night*, the s.s. *Douro* and the s.s. *Yrurac Bat* both went to the bottom with more than two score of their living burden. And who can say that the loss of the s.s. *Ville du Havre*, with its appalling death-roll, was not directly due to the colour-blindness of "look-out" or officer on one of the colliding vessels? We know how the inquiry ended. The English Admiralty decided that the English vessel was free from all blame, and the French Admiralty declared that the French vessel could not be in any way incriminated. But no one thought of attributing the mistake to the very probable one of colour-blindness. Now, what are the precautions taken to guard against those dangers which the employment of "colour-blind" and defective far-sighted sailors renders possible? We reply advisedly and after careful inquiry, "Practically none." It is true that twenty-two years *after* Dr. Wilson had so graphically described these dangers, the Board of Trade authorities awoke from their long sleep of indifference, and said that they recognized "the serious consequences which might arise from an officer of any vessel being unable to distinguish the colour of the lights and flags which were carried by vessels," and they instituted "tests and regulations," the value of which will be indicated by the following facts. The regulations do not prevent colour-blind "look-outs," colour-blind pilots, colour-blind A.B.'s, or colour-blind apprentices remaining sailors to the end of their days. They do not prevent colour-blind first mates or colour-blind captains and masters retaining their positions also to the end of their days; nay, more, they actually give colour-blind officers certificates that they are not colour-blind.

Should anyone doubt these grave statements, let him read the Board of Trade Reports for 1885, 1887, and 1888. He will find there that no less than forty-five officers rejected for colour-blindness were eventually given unendorsed certificates, which is identical to saying these men were not colour-blind, and that they were perfectly capable of taking charge of the lives of hundreds of helpless passengers, and of property to the extent of thousands. Is not this little less than a public scandal? We who know that colour-blindness is congenital and incurable, know either that these forty-five men were not colour-blind when rejected, or that they are colour-blind to-day. Which contention is the more likely may be gathered from the fact that, of these legalized non-colour-blind men, according to the Board of Trade's own reports, four were unable to distinguish red from green, twenty-two more called the colour red green, five others called the colour green red, and the remainder made mistakes of a marked character.

The Board of Trade so-called "tests for the detection of colour-blindness," viz. the requiring candidates to give the *names* of coloured cards, and lights shown them—tests which are stated to be "sufficient to prevent anyone who is more or less (!) colour-blind escaping detection by the examiner"—may be tests of a man's education in the *names* of colours, but as tests of the colour sense, they are not trustworthy, and tests which are not trustworthy are worse than no tests at all. Practically, the "tests" are barely worth the paper they are printed on. And the "regulations" dealing with a colour-blind officer, should he be detected, are of a like character, a snare and delusion. The public and the shipowners believed, rightly or wrongly it matters not, that the regulations were framed to absolutely keep colour-blind officers out of the sea service. They do nothing of the sort. With regard to the far-sight of a sailor or officer, there are no tests at all; a man may be the subject of any of the various forms of eye-disease, may have any degree of blindness, or may be so shortsighted as to be unable to see distinctly more than a few inches in front of his nose, and yet be at perfect liberty to be a sailor to the end of his days, or to become an officer. Are the public going to allow this grave condition of affairs to remain as they are? We answer emphatically "No," and we feel sure that when Dr. Farquharson brings the subject forward, the House of Commons will insist that the Board of Trade authorities who have the duty and privilege of providing for the safety of the travelling community of the first maritime nation of the world, will take, even though thus late, such precautions as will insure to the sea traveller immunity from those dangers which the present employment of colour-blind and defective far-sighted sailors renders possible.

ST. ELMO'S FIRE ON BEN NEVIS.[1]

ST. Elmo's Fire as seen occasionally at the Ben Nevis Observatory takes the form of jets of light on the tops of all objects that stand any height above the general level of the roof of the Observatory, such as the chimneys, anemometers, lightning-rod, &c. In a very fine display the tops of the objects are quite ablaze with the phenomenon, which then glows and hisses in brilliant tongues of white and blue, from four to six, or even more, inches in length. Nor is the phenomenon confined to these objects alone in the finer displays, but if the observer stands on the roof his hair, hat, pencil, &c., glow with it as well, and when he raises a stick above his head the stick has also a long flame at the top. Further, however, than having a slight tingling in his head and hands he suffers no inconvenience. The hissing is a very marked characteristic of the phenomenon, being always heard during ordinary displays, though in the feebler displays, when the light can barely be seen, it cannot be distinguished from the hissing of the wind and the snow drift. On one occasion the sound was a very highly pitched note. In the finer and even in ordinary displays St. Elmo's Fire is an object of great beauty, and the stormy character of the weather—namely, squally winds with heavy showers of snow and hail, and with clouds of snow-drift flying all around—heightens rather than diminishes the effect, although at the same time it detracts from the convenience of observing with advantage.

Up till the summer of 1888 fifteen cases of St. Elmo's

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[1] Abstract of a paper on "St. Elmo's Fire on Ben Nevis," by Angus Rankin in the Journal of the Scottish Meteorological Society, third series, No. v.

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Fire were noted at the Observatory, and these occurred all in the night-time, and all during the winter months, beginning with September and ending with February. The feebleness of the light it gives forth, in comparison with ordinary daylight, makes it difficult if not impossible to see it during the day, which is probably the reason for its being a nocturnal phenomenon, and partly for its being a winter phenomenon, for the short summer nights greatly lessen the chances of seeing it. Other reasons for its being a winter phenomenon, and not a summer one as well, are that the high temperature in summer is not favourable to its appearance, and that the weather type in which it appears is far more common in winter than in summer. The fifteen cases are distributed throughout the winter months as follows: two in September, three in October, five in November, two in December, one in January, and two in February. An investigation of these cases, and of the meteorological observations made before and after each appearance of St. Elmo's Fire, has shown that the weather which precedes, accompanies, and follows it has very definite characteristics, not only on Ben Nevis but also over the whole west of Europe. What these characteristics are will be briefly explained in what follows.

To arrive at a knowledge of the conditions obtaining on Ben Nevis, the observations of pressure, temperature, wind direction, and rainfall, made at the Observatory, were tabulated for each hour from thirty hours before to twenty-four hours after the appearance of the phenomenon in each case. The general averages thus obtained for the whole fifteen cases for each element give very decided curves. They show that, as regards pressure, the barometer, from being 24·993 inches at thirty hours before St. Elmo's Fire is seen, steadily falls till the sixth hour before, when it is 24·771 inches, and thereafter rises till the twenty-fourth hour after the display, when it is 24·979 inches. At the hour at which St. Elmo's Fire is seen and the following hour, however, a slight dip is indicated in the ascending curve. Taking all the pressure averages into account, they indicate a well-defined depression, in which St. Elmo's Fire is seen six hours after the centre, or point of lowest barometer, has passed. It is important to note that all the pressure averages come out below 25·000 inches, because this indicates that the depression occurs while Ben Nevis is in an area of general low pressure—the mean barometric pressure at the Observatory for the four years ending 1887 being 25·296 inches.

The temperature averages show a broad maximum from twenty-four to sixteen hours before and a minimum sixteen hours after St. Elmo's Fire is seen—the range being 3°·7; and between these hours there is a continuous fall in the temperature. The rate of fall is greater before than after the display. In some of the cases the range is much greater than 3°·7—in one it is 13°·4. It was chiefly from the observations of temperature that we were able on several occasions to give successful forecasts of the appearance of the phenomenon several hours before it occurred.

The chief points shown by the wind-direction averages are, that they all belong to the western half of the compass; that till the tenth hour before St. Elmo's Fire is seen the wind blows from a south of west direction, and thereafter from north of west; and that from the twenty-fourth hour before St. Elmo's Fire is seen, when the direction is south-west, the wind steadily veers till the fourth hour before, when it is west-north west, which it continues to be till after the appearance of the phenomenon, and goes on veering again till the tenth hour following, when it is north by west. This veering of the wind before St. Elmo's Fire is seen is well marked in all the cases.

The rainfall averages show two distinct maxima, the first between ten and six hours previous to the display, and the other at the hour St. Elmo's Fire is seen and the following. The latter maximum is wholly due to the heavy showers of snow and snow-hail that accompany the displays. This snow-hail differs from the usual flaky snow crystals in being of the shape of small cones with spherical bases, and being hard and dry. During the finer displays this kind of snow was always present.

Thus, as far as local observation goes, we see that St. Elmo's Fire is seen on an average six hours after the lowest reading of the barometer has been recorded, in a depression that occurs in a general low-pressure area; that it is preceded, accompanied, and followed by a falling temperature; that before it is seen the wind has veered considerably, and goes on veering for some time after its appearance; and that it is attended by heavy precipitation in the form of snow-hail.

The averages are of some interest apart from their connection with St. Elmo's Fire, for they show the relations existing in this class of storms between the four elements here discussed. The averages of pressure and of the direction of the wind are sufficient to show that the depression comes in from the Atlantic, and that the centre passes eastwards somewhere to the north of Ben Nevis. Then it is seen that the temperature is at a maximum when the barometer is falling, and is still falling when the barometer is at its lowest; that is, at a time when the atmosphere is very unstable and ascending currents at their strongest, the temperature is falling on Ben Nevis, a state of matters that must necessarily result in a rapid condensation of vapour, and a consequent copious precipitation. The rainfall averages quite agree with this.

As to the prevailing weather over the British Isles and west of Europe in general, about the times of St. Elmo's Fire being seen on Ben Nevis, the weather charts of the London Meteorological Office show that, in almost all the cases, the following conditions obtained—namely, somewhere to the south or south-east of the British Isles, usually over the south of France and over the Spanish peninsula, there was a distinct high-pressure area, or anticyclone; and that to the west or north of Scotland there was a low-pressure area, or cyclone. Between these two positions the barometric gradient was chiefly for south-westerly to westerly winds, and was usually pretty steep. The charts also showed that, so long as the anticyclone maintained its position to the south-east, so long did cyclones sweep in from the Atlantic with the above gradient wind, and pass our islands in a north-easterly or easterly direction. Thunder and lightning were noted in Ireland on several of the nights that St. Elmo's Fire was seen on Ben Nevis. Only on one occasion was any thunder and lightning observed on Ben Nevis, about the times of St. Elmo's Fire appearing, and then the phenomenon was seen two hours before the thunderstorm came on.

It might be inferred, from what has been said, that as St. Elmo's Fire appeared at the change of weather, when the centre of the storm had passed, it would be a good prognostic of improving weather. Such is not the case, however, for almost invariably another cyclone is approaching, and another spell of bad weather is experienced soon after the St. Elmo's storm has passed.

A. R.

NOTE.—Since the paper, of which the foregoing is an abstract, was written, several additional cases of St. Elmo's Fire have been observed on Ben Nevis. On one occasion we were fortunate enough in securing a photograph of the phenomenon, which shows St. Elmo's Fire as three small spots of white on the top of the kitchen chimney, the chimney being but very faintly seen.

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